High Thermal Stability of CoFe/Cu GMR Multilayer stack for Automobile Application

M. Krishnan[1], P. Predeep [2], Harish. C. Barshilia[1], and P. Chowdhury[1*]

[1] *Surface Engineering Division, National Aerospace Laboratories ,Bangalore, India*

[2] *Department of Physics, National Institute of Technology, Calicut, India*

*pchowdhury@nal.res.in

ABSTRACT

Recently, the requirement of magnetoresistive element (MRE) based speed sensors is in demand for applications in automobile sectors. However, this requires a long term thermal stability at 130 ^{0}C for a duration of 10 days. Even the development of integrated circuit and packaging needs the thermal stability more than an hourr at a temperature higher than 175 ^{o}C. In the present work, we successfully fabricated CoFe/Cu multilayer on SiO_2 substrate using ultra high vacuum (~ 10^{-9} torr) compatible sputtering system and the GMR % as a function of spacer layer is shown in Fig 1 (a). A maximum GMR of 24% in the 1st antiferromagnetic (AF) peak region and 2.5% in the 2nd AF region were obtained. Though the first AF region lacks the thermal stability above 105 ^{0}C, however in the 2nd AF region, an enhancement in GMR from 2.5 % to 10.2 % was observed after annealing at a temperature of 325^{o}C in vacuum for a period of one hour (see Fig. 1(b)). A high sensitivity of 0.13%/G with negligible hysteresis (< 10 G) was achieved within 80% of its' saturation value. Not only the high sensitivity, even the multilayer stack shows long term thermal stability at 180 ^{o}C for ten days.

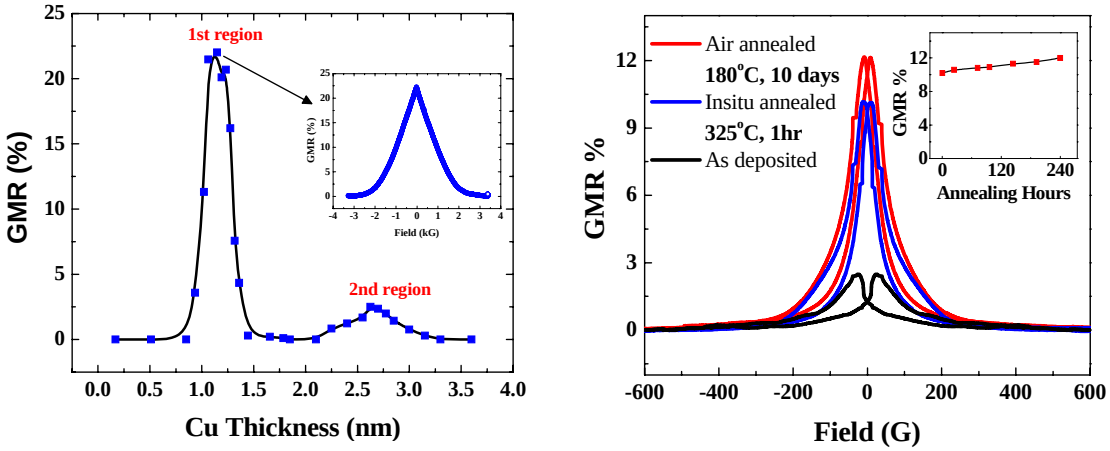

Figure 1: (a) GMR oscillation behavior for CoFe/Cu multilayer, Inset shows maximum GMR obtained in the 1st AF region. (b) MR variation of as deposited (black), in situ vacuum annealed (blue) and air annealed (red) of CoFe/Cu multilayer stack. Inset shows the thermal stability of GMR for long term annealing up to 240 hrs.